



November 21, 2017

Docket: PROJ0769

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 14 (eRAI No. 8807) on the NuScale Topical Report, "Nuclear Analysis Codes and Methods Qualification," TR-0616-48793, Revision 0

REFERENCES: 1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 14 (eRAI No. 8807)," dated May 08, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 14 (eRAI No.8807)," dated July 06, 2017
3. NuScale Topical Report, "Nuclear Analysis Codes and Methods Qualification," TR-0616-48793, Revision 0, dated August 2016

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8807:

- 29739

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad".

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8807



Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8807

**Response to Request for Additional Information
Docket: PROJ0769**

eRAI No.: 8807

Date of RAI Issue: 05/08/2017

NRC Question No.: 29739

Title 10 of the Code of Federal Regulations (10 CFR) Part 52, Section 47 and Section 79 require a final safety analysis report (FSAR) to analyze the design and performance of the structures, systems, and components (SSCs). Safety evaluations, performed to support the FSAR, require reactor physics parameters to determine reactor core performance under normal operations, including anticipated operational occurrences, and accident conditions. An approved nuclear analysis methodology is utilized to provide reactor physics parameters for use in safety evaluations. Additionally, the nuclear analysis methodology is used to establish a partial basis for demonstrating compliance with the following general design criteria (GDCs) of 10 CFR Part 50, Appendix A:

GDC 10, Reactor design, which requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

GDC 11, Reactor inherent protection, which requires that the reactor core and associated coolant systems be design so that in the power operating range the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity.

GDC 12, Suppression of reactor power oscillations, which requires that the reactor core and associated coolant, control, and protection systems be designed to assure that power oscillations which can result sin conditions exceeding specified acceptable fuel design limits (SAFDLs) are not possible or can be reliably and readily detected and suppressed.

GDC 26, Reactivity control system redundancy and capability, which requires, in part, that the control rods be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for stuck rods, SAFDLs are not exceeded

GDC 27, Combined reactivity control systems capability, which requires that the reactivity control systems be designed to have a combined capability of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.



The design description and analyses presented in TR-0616-48793, “Nuclear Analysis Codes and Method Qualification,” are presented for a single NuScale Power Module (NPM). Due to the presence of several NPMs being in relatively close proximity to each other, and the location of the ex-core detectors for a single NPM, NRC staff is questioning whether multi-module effects need to be considered. Because the methodology presented in TR-0616-48793 is focused on a single NPM, NRC staff needs to establish a finding that multi-module effects do not need to be considered for the nuclear design and analysis of a NPM. Accordingly, NRC staff requests that NuScale provide evidence to show that multi-module effects can be neglected in the nuclear design and analysis of a NPM.

NuScale Response:

This response to RAI 29739 (eRAI No. 8807) supplements the original NuScale response by providing a revised change to the Nuclear Analysis Codes and Methods Qualification topical report. This change replaces, in entirety, the original changes provided to the Nuclear Regulatory Commission in NuScale letter RAIO-0717-54771 on July 6, 2017. The topical report changes clarify that multi-module neutronics effects do not need to be considered as part of the implementation of the Nuclear Analysis Codes and Methods Qualification topical report.

Impact on Topical Report:

Topical Report TR-0616-48793, Nuclear Analysis Codes and Methods Qualification, has been revised as described in the response above and as shown in the markup provided in this response.

8.0 Application

NuScale intends to use the CMS5 code suite to perform nuclear analysis for core design, input to safety analysis, startup physics testing, core follow predictions, and operations support. The details of these applications are described in the following subsections. This topical report is also intended for use by Combined License applicants and licensees to implement core design methodology for their safety analysis calculations and operational support.

An analysis which considers the presence of surrounding modules demonstrates that there is no neutronic impact due to module proximity. As a result, multi-module effects do not need to be further considered in the application of this methodology.

8.1 NuScale Reactor Core Design Methodology

CMS5 is used to determine loading patterns to meet the NuScale energy requirement and calculate core physics parameters that meet design limits to ensure the core will meet safety analysis requirements.

8.1.1 NuScale Fuel Rod and Assembly Lattice Configuration

To meet design constraints, core designs may employ fuel rod and assembly enrichment loading schemes that control the radial and axial power distribution in the core and are designed to help limit power peaking.

NuScale loading pattern designs may include assembly radial enrichment zoning to lower the pin-to-box ratio, and help reduce the overall radial peaking factor in the core. Assembly radial enrichment zoning consists of placing fuel rods of different enrichments in specific lattice locations within an assembly. The fuel rods containing the lower enrichment are generally placed in the high flux regions of the lattice that may include the corners, along the outside edge of the assembly, or around the instrumentation or guide tubes.

Fuel rod axial enrichment zoning is the use of different enrichments within the pellet stack of a fuel rod. Fuel rod axial enrichments are utilized to lower the axial leakage and to shape the axial power profile (reduce axial peaking). “Blankets” are areas of lower pellet enrichment placed at the top and bottom of a pellet stack to reduce leakage. These blankets, in effect, act as a reflector and improve fuel utilization. “Cutback” regions are areas in a BP fuel rod that do not contain BP. The cutback region does not necessarily contain a reduction in the ^{235}U enrichment as is done for the region containing the BP (Section 2.4). Cutback regions are used to shape the axial power shape of fuel rods containing BP. The NuScale reactor core may employ blankets and cutback regions in the fuel.

Cross sections for all assembly lattice configurations and fuel rod loading configurations necessary for the SIMULATE5 model are generated in CASMO5.